Project Programming and Commissioning as a Risk Mitigation and Threat Analysis Tool

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Abstract: As a quality process, commissioning has been successfully used in the design, construction and validation process for over a decade with valuable results. Owners of high risk and complex projects are now starting to use the commissioning process beyond traditional disciplines including risk/threat analysis and mitigation programs.

This paper discusses the growing trend of using a commissioning approach as a documentation process for the validation requirements, which are documented in the study, programming, and implementation of threat/risk analysis and mitigation programs.

1.THE PURPOSE OF COMMISSIONING

The basic purpose of building commissioning is to provide a quality based process with documented confirmation that building systems are planned, designed, installed, tested, operated and maintained in compliance with the Owner's project requirements (OPR). Sophisticated Owners throughout the United States have documented the value of commissioning in numerous studies including work done by the GSA, DOE and PECI[1]. As a successful and accepted quality assurance program for the built environment, a logical leap occurred when commissioning expanded from a single mechanical perspective to a system-level focus. Early work in commissioning was confined to mechanical systems. In the mid 1990s, the commissioning process was expanded to the whole building including architectural, electrical, plumbing, life safety and fire protection, as well as numerous other systems that are considered project-specific (laboratory, medical, process equipment, etc.). In the post 9/11 era, new security and threat mitigation systems have become necessary in mission critical and/or high profile buildings. In another quantum leap forward for project delivery, the use of the commissioning model has shown significant benefits when used to document and validate risk and threat mitigation systems.

During the last several years WorkingBuildings and Hellmuth, Obata + Kassabaum (HOK) have applied this expanded view of commissioning in several mission critical high containment projects with extraordinarily successful results. We have been able to control specific project costs by employing a technique that keeps us focused on certain mandated risk and threat design aspects without being overly complex.[2] While we cannot say that this process has lowered our overall project fees, it has helped us meet our clients' needs while keeping our expenses and focus in alignment with requirements of the project.

2. THREAT ANALYSIS/RISK MITIGATION AND THE COMMISSIONING PROCESS

Every organization has a unique threat profile defined by factors including location, operational activities, public profile, internal procedures and

[1] Commissioning definitions can be found at bcxa.org, peci.org and wbdg.org

[2] Jeff Schantz, AIA Director of Science and Technology Hellmuth, Obata and Kassabaum speaking on the benefits of Risk Threat Analysis in the commissioning process for Biological Defense and First Response Facilities.

others. A threat analysis and risk mitigation program identifies which vulnerabilities can be mitigated by a specific countermeasure and helps owners implement the appropriate policies for each system and/or building.[3] For complex and mission-critical projects, it is crucial that a set of well-defined methods be used to assess risk levels and provide quantitative, prioritized countermeasures.

Commissioning[4] is defined as a systematic process of assuring that a building performs in accordance with the operational program requirements. The process ensures, through documented verification, that all building systems perform interactively according to the Operational Performance Requirements. The process also ensures discovery of flaws in the design and construction phases that preclude facility operation in accordance with parameters set forth by the Owner. Based on the successful implementation of this quality process, commissioning can be used as a tool to ensure compliance in a threat analysis and mitigation program. Similar to commissioning a hard system, the commissioning quality assurance process can be used to document and validate the threat risk mitigation process, which may be applied to soft and hard systems. This expanded commissioning process has been used successfully by our team in many high performance, mission critical projects in the United States including projects for Centers for Disease Control and Prevention (CDC), United States Department of Energy National Laboratory Program, and the Regional Biological Defense Program. As a starting point in this discussion, a look at project risk and threats from a commissioning perspective follows.

2.1. Project Risk

Project risk occurs in the areas of health, safety and environment, which affect the overall cost and success of a project. As a commissioning authority, who has the technical qualifications to combine this approach, our team analyzes and responds to risks that can affect the success of a project including the whole investment and operational goals of the project. We have adapted and modified a process called *Risk Analysis and Management in Projects*[5] (RAMP). This process can be used in many components found in the design and construction techniques of today, not only in financial analysis where it was born. By quickly analyzing threat potential (internal, external, man-made or naturally occurring) and developing risk mitigation models and policies during the program phase, a detailed development and implementation and validation schedule can be integrated into the master project schedule. The goal in this early phase is to ensure that all aspects of threats and risks have been taken into consideration and that the knowledge is shared and utilized within the entire project team. This process will provide program management a complete profile of risk factors that will need to be addressed, without the complexity of numerous and conflicting resources. The risk analysis process we have adopted comprises four main activities; process launch, risk review, risk management and process close down. These four steps fit neatly into standard commissioning phases; design review and the development of performance and operational requirements (process launch), design review (review of risk), functional performance testing (risk management), and transition management and acceptance (process close down).

[3] Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings (FMA 426) and The Building Design for Homeland Security Training Course (FEMA E155), Primer for Design of Commercial Buildings to Mitigate Terrorist Attacks (FEMA 427).

[4] In accordance with ASHRAE, BCA and General Services Administration

[5] RAMP, Risk Analysis and Management for Projects was developed by a joint working party of the Institution of Civil Engineers and the Faculty and Institute of Actuaries London England

When one looks at a project, there are typically three types of project-level risks that impact the overall success:

1.) Risk to the health and safety of people, including personal injury and loss of life.

2) Risk to the environment, including pollution, and damage to flora and fauna.

3) Risk to activity, in this context a project, including damage to equipment, loss of function (intended output), loss of research, and loss of use due to construction delays.

Fig. 1. The RAMP Process

Traditionally these three areas are connected by a cost that determines how much time and money should be spent in mitigating the risk to acceptable levels. The main goal of commissioning is to deliver a facility that will meet the OPR, budget and schedule. If project budgets were unlimited, then the cost associated with assuring that the design and construction and operability of these systems would function, as intended would have little impact on the overall success of a project. As most budgets are not unlimited, a selective method or justification of cost vs. risk must be addressed. *Modernizing Construction*[6] states that risk assessment, allocation and management are essential and must be an ongoing process throughout the life of a project, as risks will be constantly changing.

2.2Threat Analysis

Another important element of success criteria for a building is not only the cost risk, but also its ability to survive a threat[7]. Practical threat analysis identifies system vulnerabilities, maps system assets, and assesses the threat risk for a specific project, lowering system risk to a minimal, acceptable level. Threat analysis is most effective when used in the design intent phase and continues as an ongoing process throughout the project's lifecycle.

Prior risk mitigation procedures typically focused on the physical aspects of a project and a process to protect function and cost. In today's world, the risk to the project from naturally occurring environmental threats (weather) and manmade threats (terrorism) must be incorporated into a high performance, containment or high profile project.

Terrorism is real, evolving, and continues to increase in frequency and lethality throughout the world. The terrorist's unyielding, tenacious and patient method for targeting interests, forces us to closely examine existing policies and practices for deterring, disrupting and mitigating potential attacks[8].

An effective planning process to facilitate the necessary decision-making method, reducing the impact of a terrorist or natural event, should be incorporated into every project and clearly documented in the OPR. Although predicting the specific threat to everyone is not possible, proper planning and integration of those plans provides a solid foundation for preventing and reacting when terrorist incidents or other emergencies unfold. Taken as a separate service or combined with a risk mitigation program, the goal is to provide the necessary planning so that the proper operational aspects and intended reactionary modes of operation within the building are achieved with predictable, planned and concise results.

[6] Modernizing Construction, the Stationery Officer, London 2000, ISBN: 0 10 276901 X.

[7] See table X

[8] Unified Facilities Criteria (UFC) 4-010-01 DoD

In today's world, it is critical to incorporate a process that identifies the relevant, credible threats that align with the project's unique threat profile. That process must be included in the commissioning documentation and validation process. Only qualified professionals should develop a risk threat analysis. In our projects, a trained commissioning authority provides this analysis. If the commissioning provider does not have the experience, then a qualified professional should work with the commissioning provider to develop and incorporate this information into the overall commissioning and validation program. The analysis, specifications and success criteria are vital for the proper validation of the building response systems. Using advanced analysis and forecasting techniques, we are able to analyze the risk levels and exposure for each threat. We typically provide the Owner with an in-depth assessment of potential risk areas, including operational processes, supply and delivery chains, communications protocols, and emergency procedures.

3. RAMP PROCESS

3.1Commissioning as Mitigation

The RAMP process consists of four activities, shown in the process flowchart and described below.

In our projects we have demonstrated that an experienced commissioning authority is an ideal candidate to coordinate all the activities related to risk and threat mitigation. The sequential steps of the RAMP process closely mimic the commissioning process. During the first step of the RAMP and commissioning processes, baselines and assumptions are being established and documented. They will spell out the objectives, key parameters, lifecycle goals, principal activities and time lines, and success criteria.

The following example documents one element of what could be expected for the RAMP process and commissioning a high containment facility:

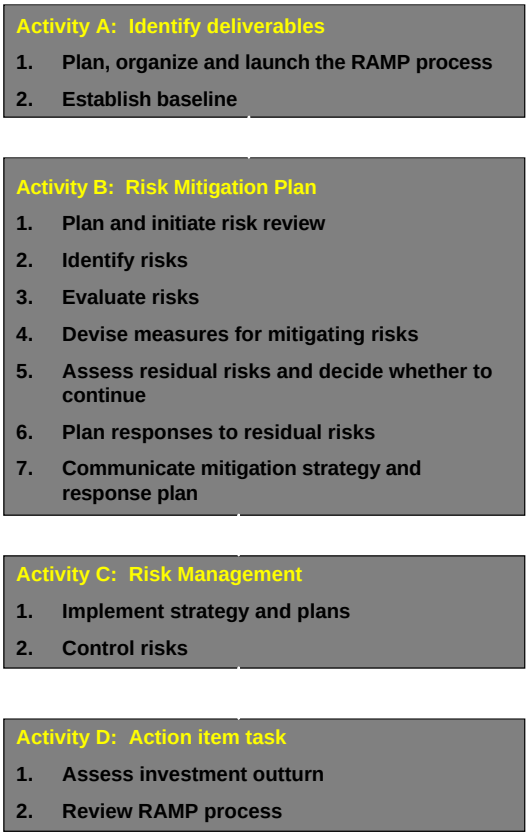

Fig. 2. RAMP Process Activities

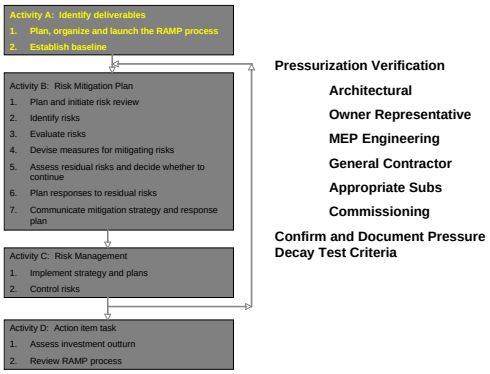

Fig. 3. RAMP Process Activity A

The starting point is to develop the stockholders' roles and responsibilities, and confirm the required performance and testing procedures.

The next activity is to develop the mitigation plan. In our example, this would include items such as design and construction details, and group risk to be considered. The desired outcome, scope and level of the risk review are established in a document, identifying all significant types and sources of risk and uncertainty associated with the

intended objective and potential failures. Each significant or potentially significant risk identified is evaluated with the goal of:

- Reducing or eliminating the risk
- Transferring the risk
- Avoiding the risk
- Absorbing the risk
- Obtaining better information to reduce the uncertainty

At the conclusion of this review, a document will outline the main risks, a containment plan to minimize the risk(s) and impacts, and contingency plans to deal with the potential impact of each risk. The report also comments on the effectiveness of the review, problems experienced, lessons learned, and recommends improvements for future reviews.

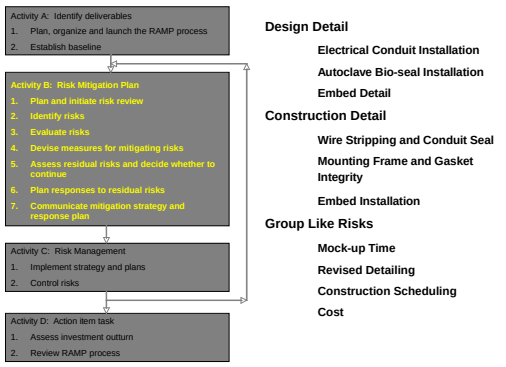

Fig. 4. Ramp Process Activity B

The next activity is to develop a risk management program. Residual risk analysis and mitigation strategy is then implemented in the project with named individuals responsible for each action. Actions are monitored to ensure they are completed in a timely and satisfactory manner. Any changes or developments during implementation are reported to the commissioning authority for documentation and reporting.

The final activity is the close out or action item, reviewing the process used to resolve and/or document the current issue. The results of this review are recorded in a formal report, which compares the results with the original objectives. An assessment is also made of the risk and impact that occurred in comparison with those anticipated. Lessons learned and suggested improvements are recorded for future aspects of the project.

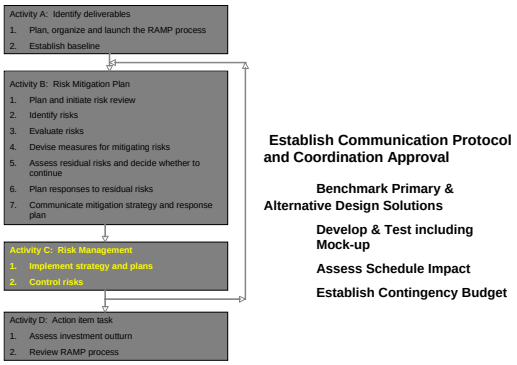

Fig. 5. RAMP Process Activity C

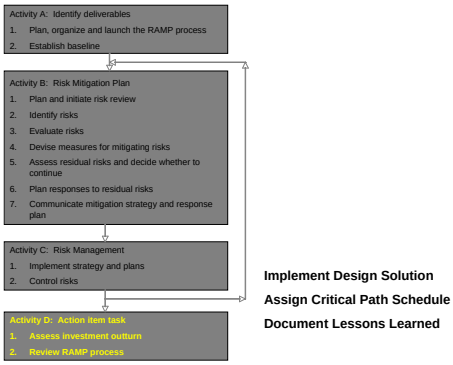

Fig. 6. RAMP Process Activity D

3.2Project Studies

The project name is withheld per client request and will be referred to as Project A.

Project A

Size: 190,000 SF

Project Cost: $139 million

Facility Type: High Containment BSL 3/ABSL-3 Laboratory

In this facility, WorkingBuildings was engaged to provide the following services: commissioning, risk threat analysis, risk mitigation program, and developing standard operating procedures for high containment areas. The commissioning process is being used to track and validate the findings of the risk/threat analysis. In the initial review of the original building program, numerous inconsistencies and omissions were documented as it related to a threat profile by our team. Using the processes outlined in this paper, the risk to the project was deemed significant, (original program detailed lower risk factors based on out

dated design concepts) and a change was authorized in the design phase to address risk elements and performance requirements. Since our analysis and recommendations affected the entire building design, the cost to implement the mandated security requirements was higher than the original budget. If these issues had not been found until after design was completed, the cost would have been even higher to a factor of 10. Based on the Owner's performance requirements and the risk profile, the change was deemed acceptable and necessary. By validating the building requirements and program goals, through the use of commissioning process verification, significant financial pitfalls were avoided not to mention the opportunity cost savings found in a building that was deemed mission critical with a required up time of 100% x365x24.

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Fig. 7. Category and Composite Ratings

4. CONCLUSION

Total Project Risk Mitigation

The purpose of implementing a risk mitigation plan is to accurately identify countermeasures and their relationship to project and facility vulnerabilities. A thorough risk management program offers security and continuity planning against a terrorist attack or other catastrophic event. A risk mitigation program provides practical risk management solutions to close potential security gaps, optimize emergency response capability, ensure operational continuity, and significantly lower risk and liability in the event of an emergency. Together these two elements combined with an overall quality assurance program must be taken into account in our standard design and construction practices. By combining the elements of risk, threats and mitigation into a quality assurance program such as commissioning the building Owner can be confident that all aspects of risk and threat are being tracked throughout the process.

A properly trained commissioning authority with risk and threat experience recommends project-specific procedures to ensure facility security, and coordinates with Owners to implement recommendations and oversee the integration of security protocols and training programs. These include security systems and processes, operational systems, emergency protocols, personnel training programs, continuity planning, mapping assets, vulnerabilities, threat analysis, and implementation of a risk mitigation plan.

Today's projects frequently engage an army of consultants. While the needs of the Owner are being met by this large group, widespread duplications, improper use of resources, and lack of a unified quality assurance program leads to disarray, improper use of resources and cost and schedule burdens. These factors and inconsistencies tend to increase project cost, without necessarily adding value.

This new commissioning approach coordinates communication protocols, establishes checks and balances and a well-documented validation protocol. In our work we have found that the process streamlines efficiencies, which in the long run increase the productivity of the team, and enhances the desired outcome with significant cost reduction.

5.ACKNOWLEDGMENTS

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[2]The Engineering Council, 1993. Guidelines on Risk Issues, London, ISBN 0 9516611 75.

[3]HSE, 1994, 2002. "Managing Health and Safety in Construction," Construction (Design and Management) Regulations, Norwich, ISBN: 0 7176 2139 1.

[4]The Stationery Office, 2000. Guidelines for Environmental Risk Assessment and Management, London, ISBN: 0 11 753551 6.

[5]The Stationery Office, 2000. Modernizing Construction, London, ISBN: 0 10 276901 X.

Fig. 8. Process Flow Chart.